COMPOSITE REPAIR OF LARGE FUSELAGE FRAME STRUCTURE

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Objective/Approach

Objective:

• Investigate the possibility of using composite doublers to repair fatigue cracks in thick forgings or fuselage frames

• Develop and economical testing approach to examine the feasibility of these repairs on specimens of representative size

Approach:

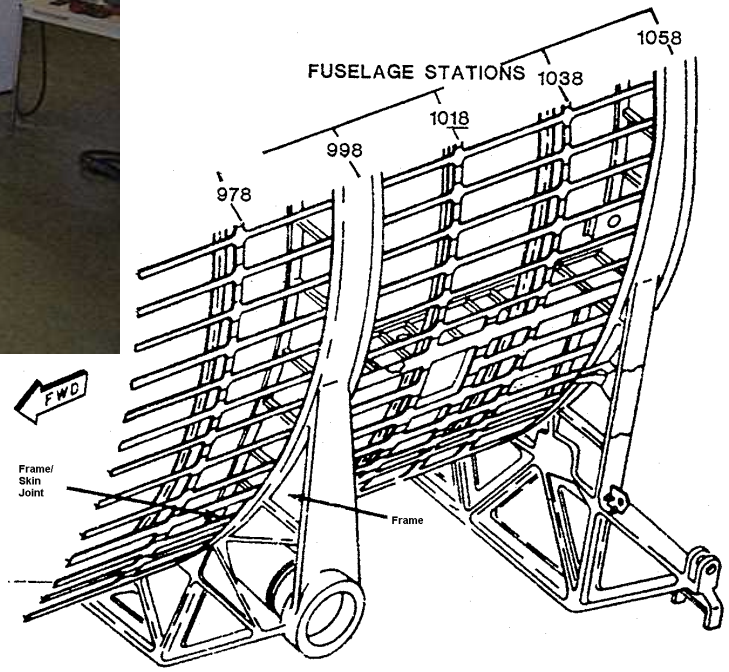
• Devise a repair scenario that created a growing crack that is a function of a complicated stress field in a region of a large forging that would be difficult to repair.

• Fabricate a test rig that could inexpensively create this complicated stress field in surplused 998 Frames from the C-141

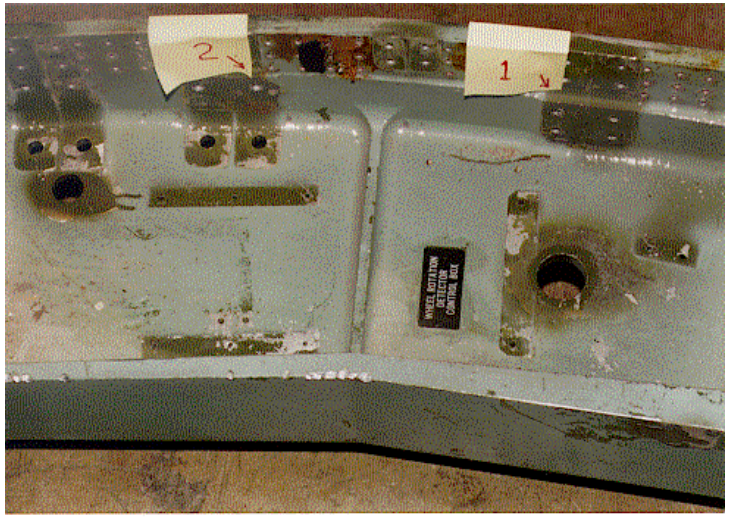
Project Outline

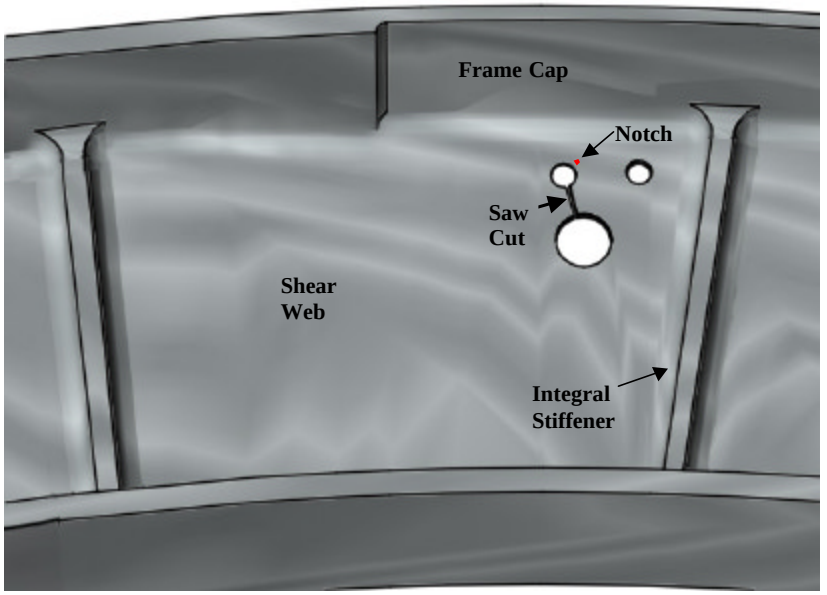
- **Examine 998 Frame For Flaw History**
- **Analyze 998 Frame For Useful Flaw Development**
- **Devise An Inexpensive Test Rig For Fatigue Testing**
- **Conduct Preliminary Testing**
  - Test Area Selection
  - Develop Desirable Flaw Growth For Repair
  - Cocuring Fabrication Approach
- **Install Flaw/Precrack Test Article**
- **Cocure Composite Repair Doubler**
- **Fatigue Test**
- **Static Test To Failure**
- **Post Test Evaluation**

Test Article

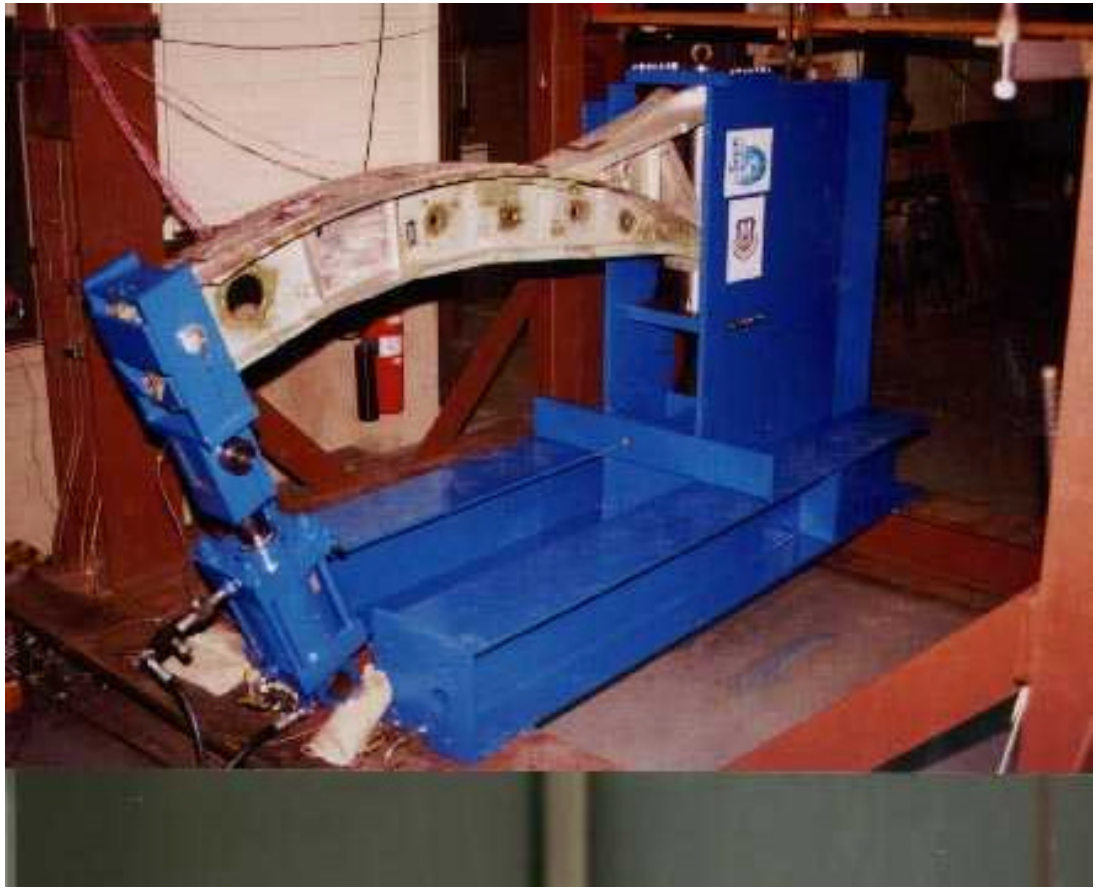


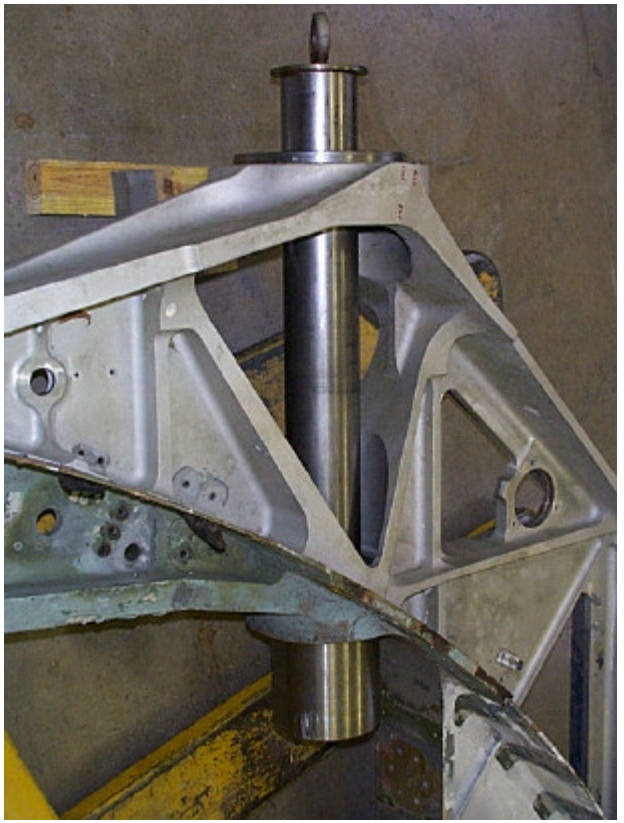
Test Area



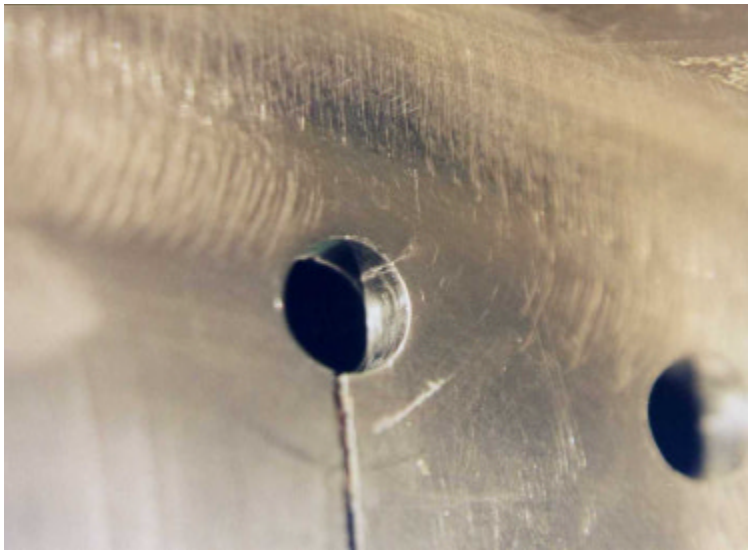


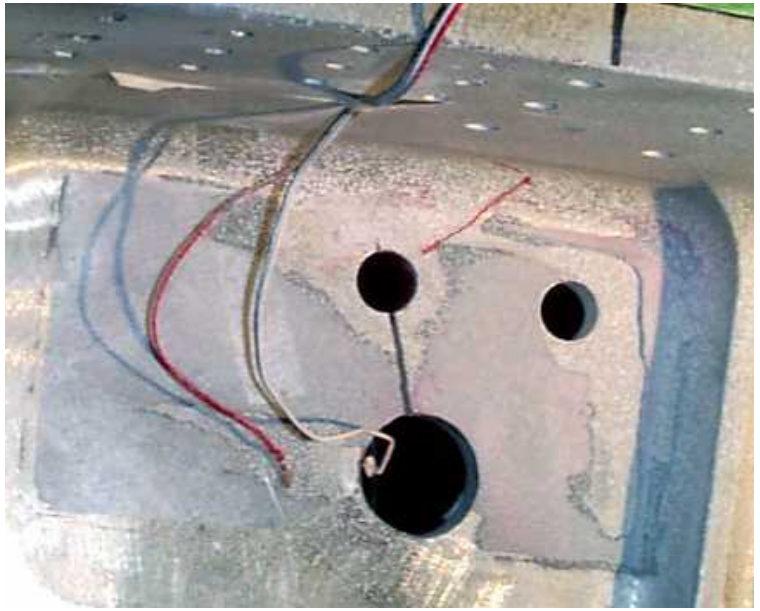
Test Setup



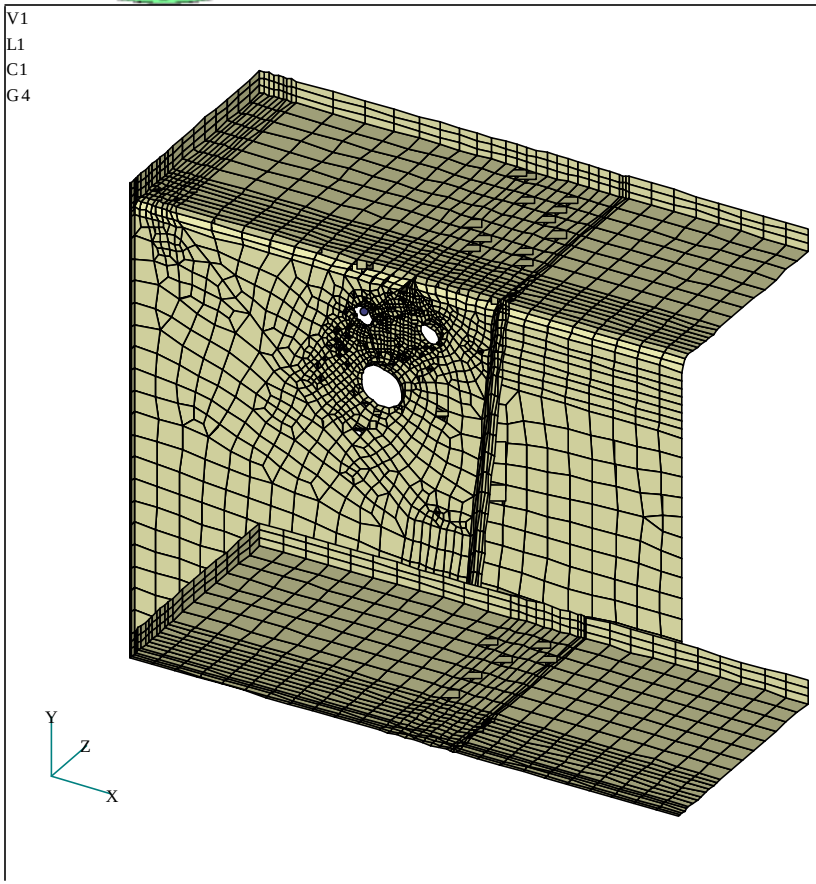


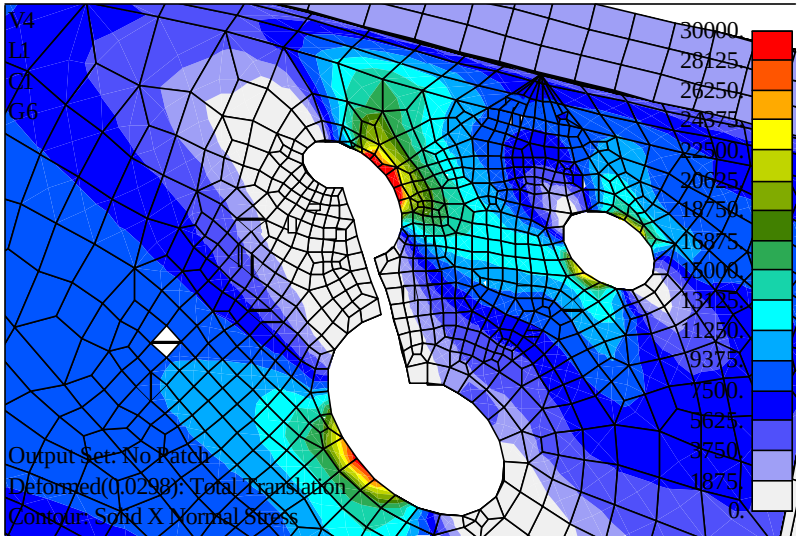
Initial Crack Geometry



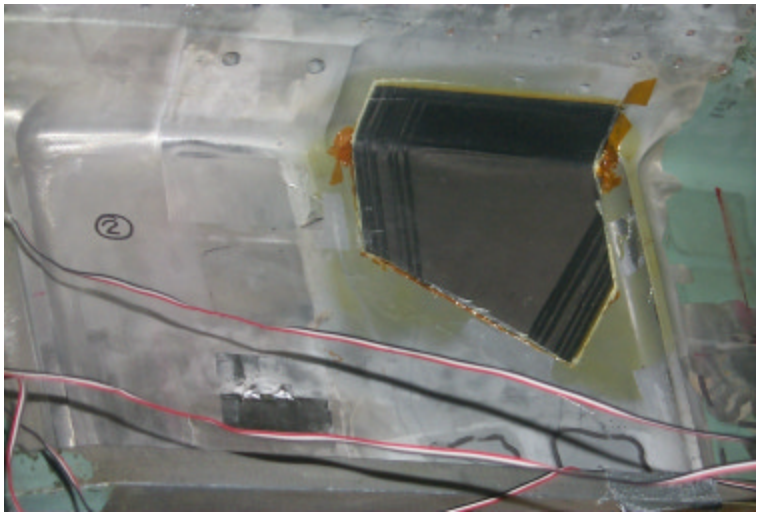


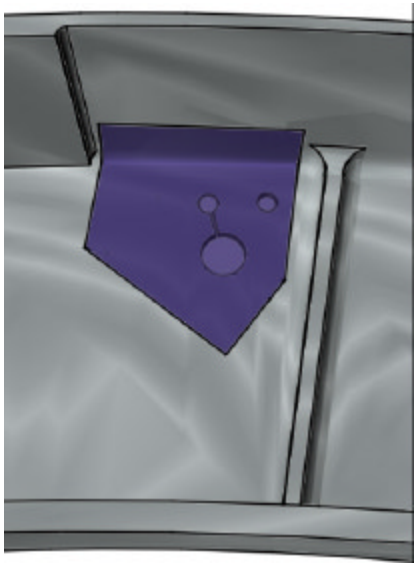
FEM Of Test Area

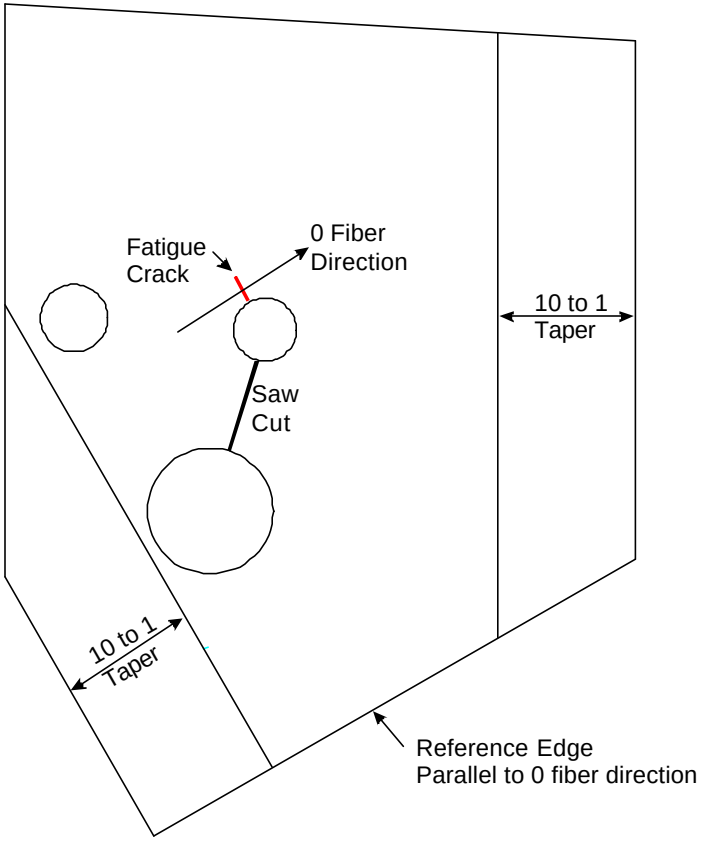




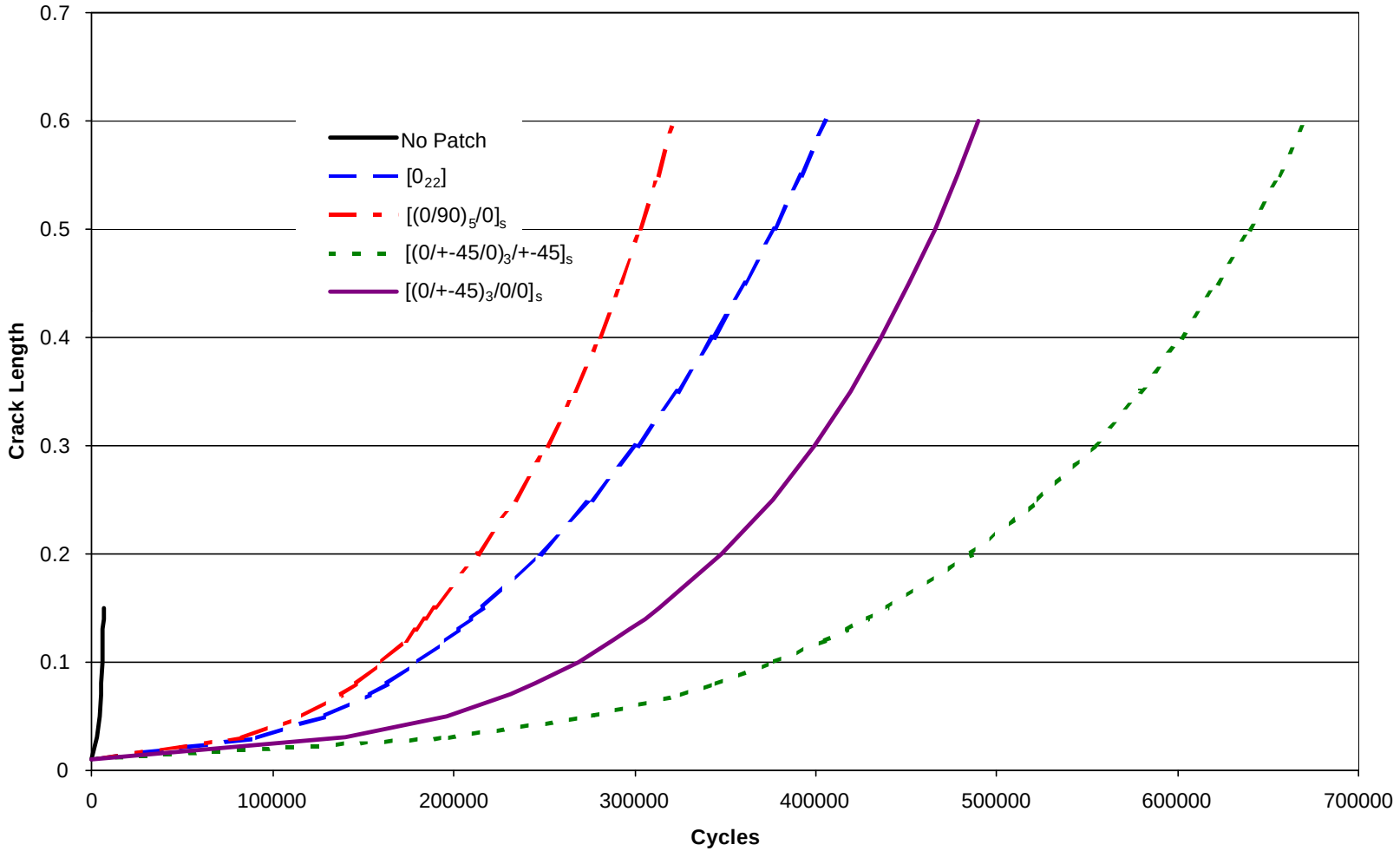
Doubler Geometry



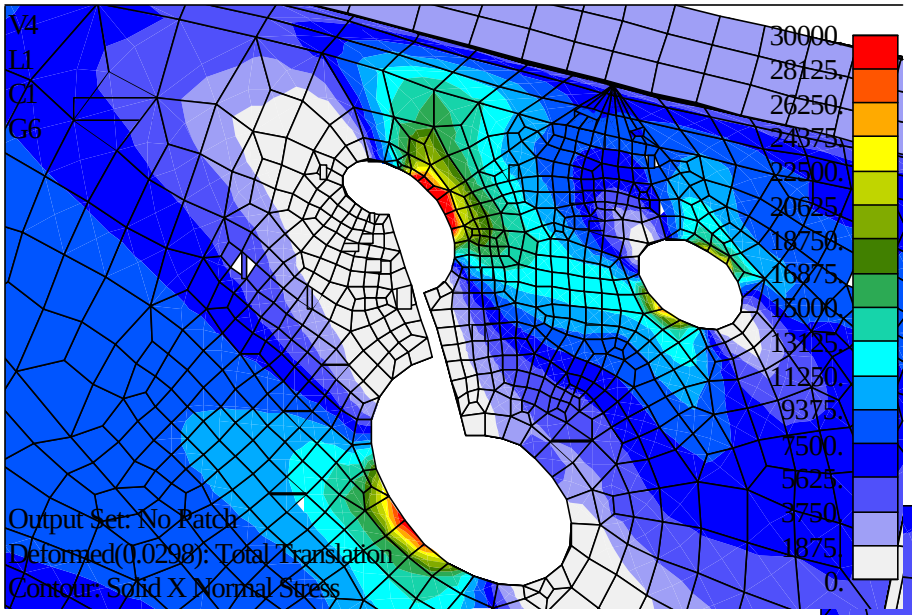




Doubler Comparisons

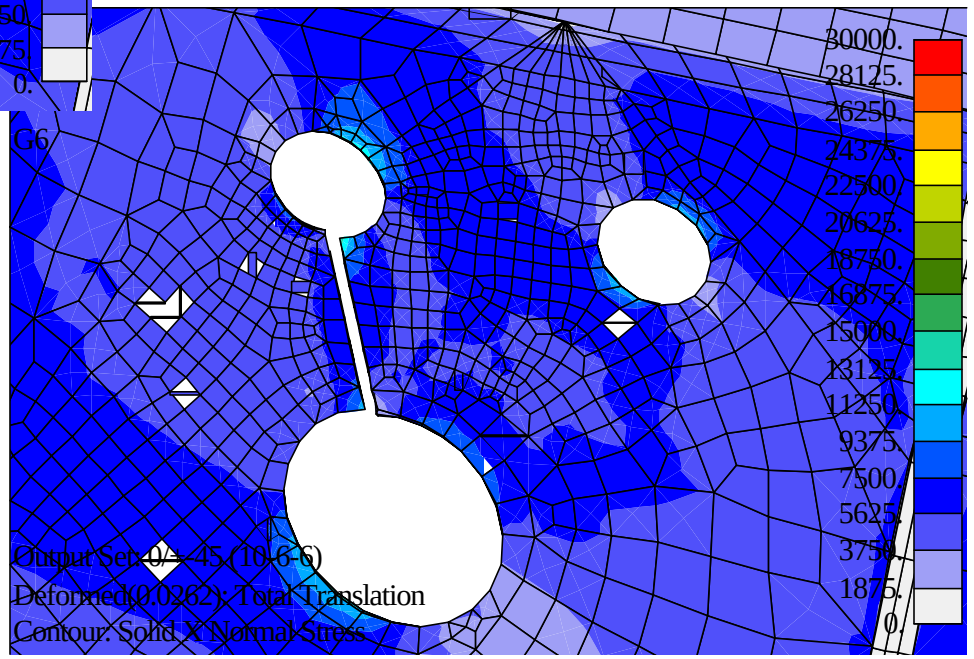


FEM Of Repaired Test Area

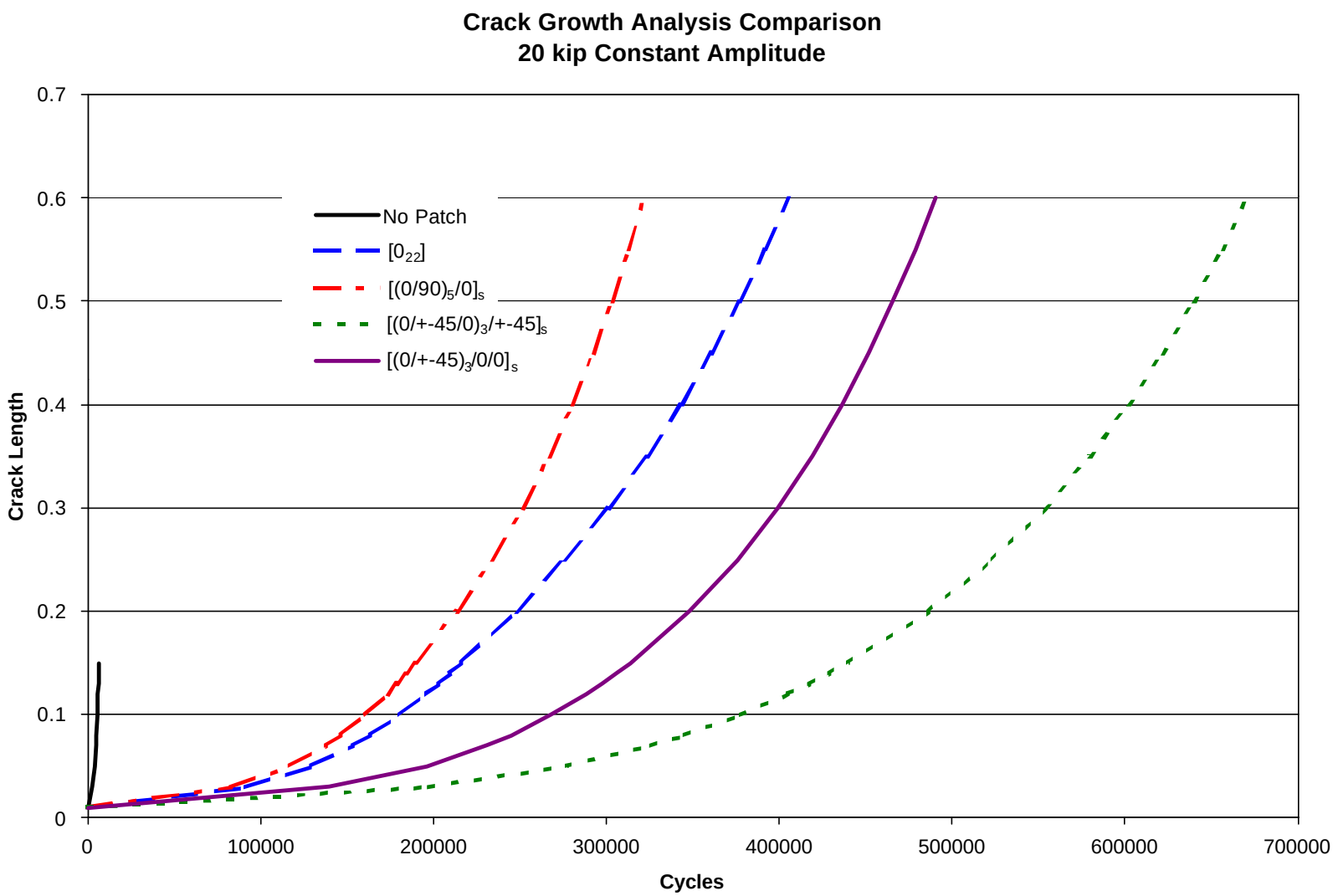


Unrepaired

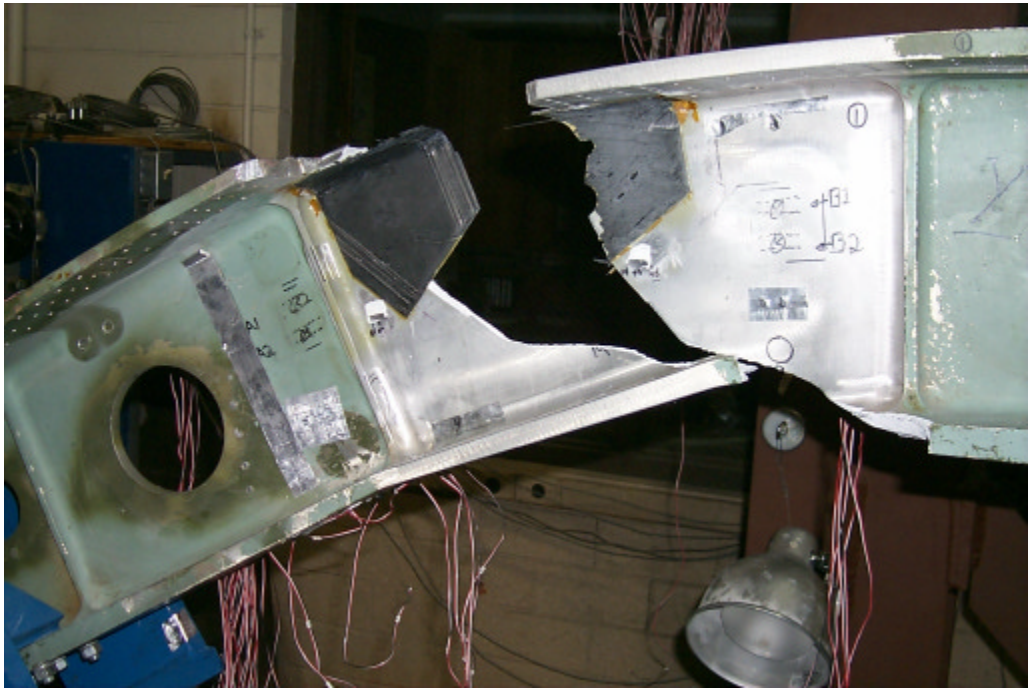
Repaired



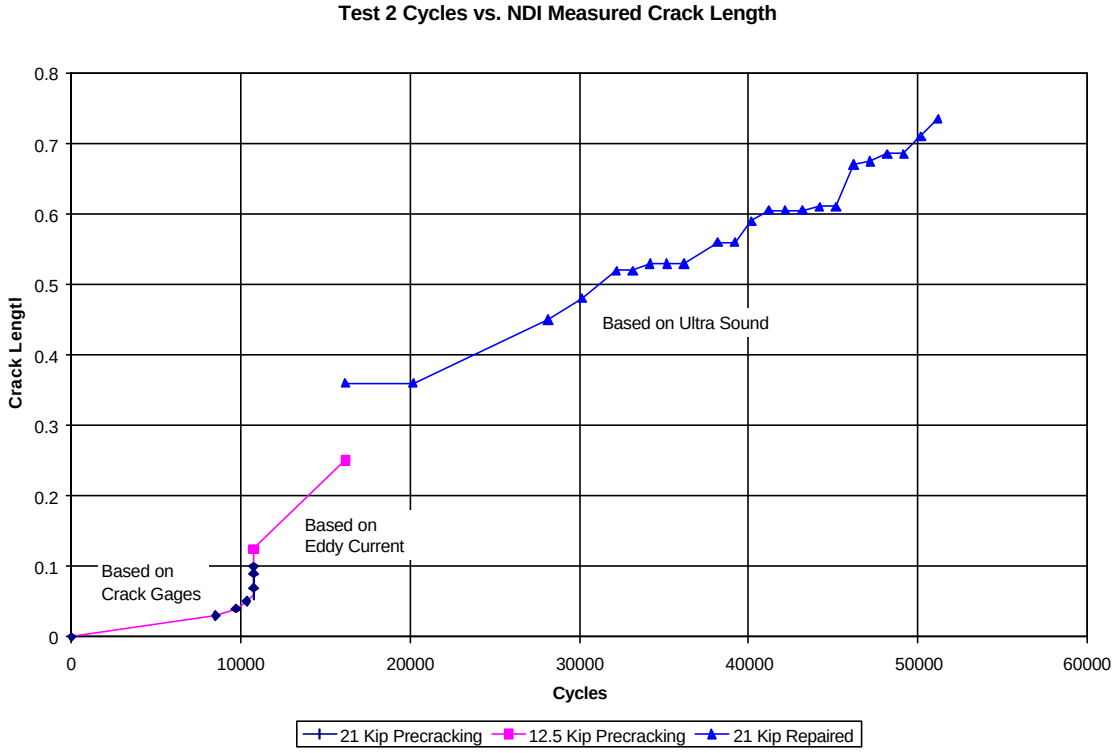
FEM Of Repaired Test Area



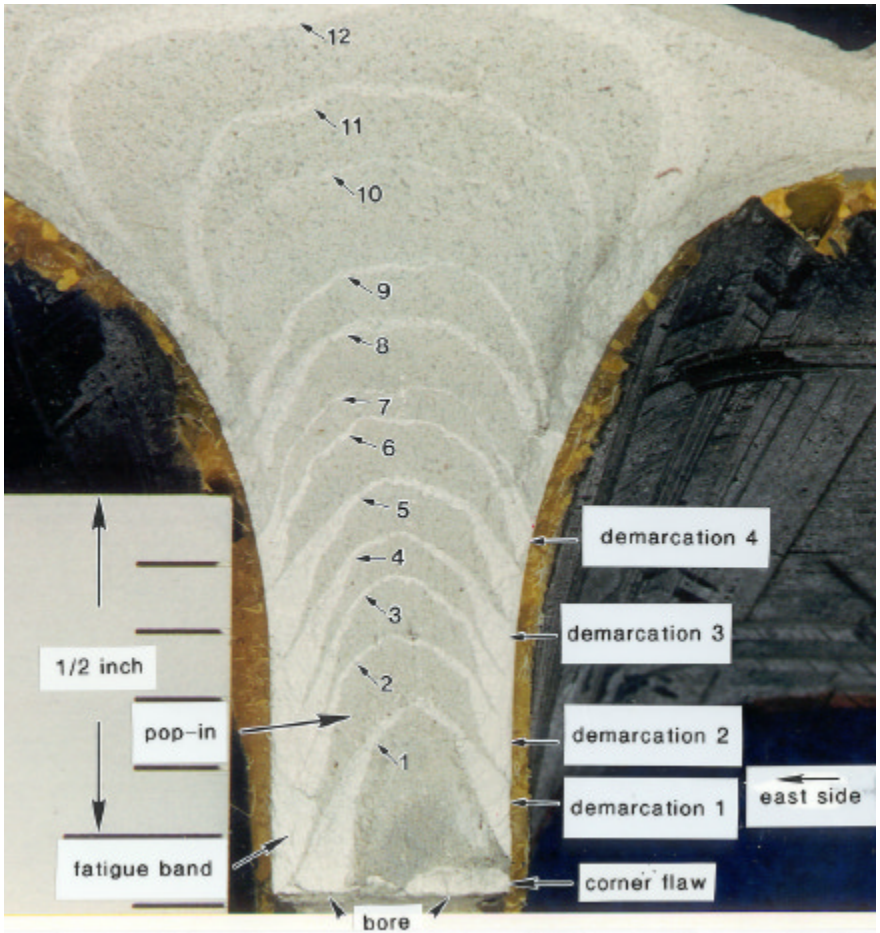
Failed Test Specimen



Crack Growth



Fracture Surface



Conclusions

- **The 998 Frame & Simple Test Rig Can Provide Useful Test Bed For Basic Thick Frame Repair Investigations**

- **Graphite Doublers Can Conform & Be Successfully Cocured To Difficult Repair Areas . . . *They will stay on!***

- **Cocuring On the A/C Can Offer Inexpensive Repair Alternative To Major A/C Teardown & Frame Replacement**

- **Composite Repair Doublers Can Solve Thick Fuselage Frame Fatigue Cracking Problems Without Major A/C Disassembly**

- **Installation Suggests In Extraordinary Circumstances Depot Field Repair Team Can *Go To The A/C* To Get It Flying Again**

Recommendations

- Examine If Precured Doublers Could Be Beneficial
- Examine Ways To Recover Holes
- Examine Ability To Install Fasteners In Doubler
- Examine Effects Of Loaded Fasteners To Double Integrity
- Examine Stress Corrosion Crack Repair Approaches
- Examine Spindle Repair Approaches